6 Reconfiguring the public of science

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Abstract This paper reconsiders recent changes in science–public relations in France in the light of earlier ideas about the role of the lay public. A broad historical perspective shows that the categories used to describe communications between knowledge producers and society have been reconfigured again and again (Secord 2004). Notions such as such as 'savants' and 'amateurs', 'popular science' and 'science mediation' are historical constructions heavily dependent on the institutional conditions of scientific research and on its technological applications (Topham 2009ab). This paper first emphasizes the epistemic and social conditions of the construction of the notion of the public as 'those who do not know' in the 20th century. It then tries to understand when and how the notions of 'citizen science' and 'participatory science' emerged. Finally, through a brief survey of various modes of participation developed over the past decade, it questions the notion of a radical change or paradigm shift.

Keywords

Deficit model, participatory model, citizen science, public engagement in science,

6.1 The construction of the deficient public

Over the past century, science and society issues have been framed around the evidence of a divide between scientists and the lay public. There were two entities: the small scientific elite—the '*savants*'—on the one hand, and the mass of those who do not know—the '*ignorants*'—on the other.[2] All efforts at popularizing science were aimed at bridging an increasing gulf between scientists and the public. The popularization enterprise was thus considered as a necessary consequence of the progress of science.

Since the late 20th century, new catchwords such as 'citizen science' and 'public engagement in science' have spread around Europe. Suddenly the public seems to be allowed to have a say about scientific and technological topics. So striking is the change that historians and social scientists describe this episode as a paradigm shift: from a *deficit model*—in which the public was defined negatively as 'those who do not know'—to the *participatory model*—in which the public is invited to take part in the scientific enterprise (Broks 2006, Schiele 2008).

2 See, for instance, Raichvarg & Jacques (1991).

How are we to understand this changing image of the public of science?

In the 20th century, it was tacitly assumed that the progress of science has a cost: most people—99% of the population—are left behind. And the challenge was to bridge the gap through campaigns of popularization. In 1939 the author of the article 'La vulgarisation scientifique' in the *Encyclopédie française* insisted on the increasing difficulty of the task of science popularization:

> Jadis le problème (de la vulgarisation) aurait été facile car la science était peu avancée, les savants étaient des amateurs et il y avait peu d'écart de culture entre eux et les gens du monde. En outre la langue qu'ils parlaient était la même. Aujourd'hui l'abîme s'est creusé entre les créateurs de la science et l'homme moyen. Etroitement cantonnés, les savants sont d'autant moins compris qu'ils ont un vocabulaire et des tours d'expression particuliers. Le nombre des faits et de principes qu'il faut connaître pour suivre l'évolution d'une science est considérable et l'apprentissage est rebutant. Tout concourt à rendre la vulgarisation difficile. (Sudre 1939)[3]

In surveying the changing relations between science and the public over time, Sudre distinguished three periods. In the dawn of modern science, the scientist and the layman differed only in their style of argumentation, and Descartes' or Newton's cosmologies were popularized in the salons. Later on, according to Sudre, the increased formalization and mathematization of science in the 19th century created a difference of language: translation was needed, from the scientific language into ordinary language. Popularization thus developed as a process of translation. It was still possible to bridge the gap.

The 19th century was admittedly the golden age of popular science. Science magazines, science museums and popular science publications were booming in France and many industrialized countries (Bensaude-Vincent & Rasmussen 1997, Bensaude Vincent 2009). This mass consumption of science was enabled by material conditions, such as new techniques of printing, cheap presses, railways, and greater literacy among the population. Yet it also presupposed that the distance between the scientific elite and the public could be overcome. The continuity between science and common sense was the basic assumption, underlying and even inspiring most 19th century popular enterprises.[4] The gap between scientists and the public was viewed as accidental rather than essential and did not disqualify the public's knowledge. Laypeople had to catch up, to follow the progress of science and technology, which was assimilated with the progress of civilization itself.

In the early 20th century, after the development of relativity theory and quantum mechanics, Sudre continued, translations from scientific language into vernacular language were no longer possible because the notions introduced by physicists had no equivalent in the common intuition of space and time. Scientists and ordinary people lived in two different worlds. An ontological gulf came into being: no common reference allowed the process of translation. This radical break

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[3] See also Bensaude-Vincent (2001a).

[4] This credo has been clearly formulated by Auguste Comte. Positive science, in contrast to metaphysics, emerged out of common sense. See Bensaude-Vincent (1991).

between science and the public threatened the popularization agenda: to put 'science in every one's reach'.

In the interwar period, the 'new physics'—relativity theory and quantum mechanics—became favourite topics of science popularization despite the assumption of an ontological gap. In fact, as the 'science = progress of civilization' equation became less and less obvious in the aftermath of World War I, popularizers had to promote the notion of pure and disinterested science. Star scientists were celebrated as geniuses concerned with the pursuit of truth, living in a spiritual world, ignoring economic interests and national boundaries. Science was beyond good and evil, beyond moral judgements. Theoretical physics became the model science, and the distance between science and common sense became a cliché. Gaston Bachelard's epistemology of rupture was largely inspired by this campaign. With non-Euclidian geometries, relativity theory and quantum mechanics, the 'new scientific spirit' required a radical break with common-sense views.[5] So distorted were the non-scientists' views that they had better keep silent and never express their opinion. Immanuel Kant's famous injunction '*Sapere aude*' ('Dare to know!' (Kant 1784)—never rely on others' opinions but cultivate your own faculty of judgement—no longer made sense. Laypeople would necessarily have to rely on experts. Ironically, a direct impact of the advancement of scientific rationality was the collapse of the Enlightenment motto 'Have the courage to use your own understanding.'

How to understand this paradox? The notion of laypeople as deprived of science is a social construction linked to a specific practice of science. Whereas science in the 18th century was a social activity open to amateurs, in the 20th century lay practices of science, popular and indigenous knowledge have been disqualified as pseudo-sciences. Legitimate science is the specific practice of academic communities working in public or private research laboratories, and ruled by their own systems of values and evaluation (the peer review system). As a result, non-scientists could never challenge the authority of professional scientists.

Could that authority be challenged by science mediators—those who occupied the allegedly increasing gap between science and the public? Science writers and journalists became professionals in charge of spreading an image of science among the public, rather than enlightening the public (LaFollette 1990). In the aftermath of World War II, they very efficiently spread a positive image of nuclear physics as a source of clean and cheap power rather than as a military weapon.

However, dazzling images meant to reinforce the public acceptance and acclamation of scientific research did nothing to bridge the gulf between scientists and the public. In the 1980s, alarming surveys of the public understanding of science in industrialized countries raised a political concern to increase 'scientific' literacy. The mission of science mediators was to augment public knowledge of scien-

[5] In 1938, Bachelard presented opinion as the major obstacle to the 'formation of scientific spirit'. He even deprived laypeople of their capacities for thinking and judging ('l'opinion pense mal, elle ne pense pas') (Bachelard 1972:14).

tific topics—to spread scientific rationality within society. The mission was never to open the scientists' minds to other forms of rationality and other styles of thinking. It was a one-way flow from the source of knowledge production to the mass of knowledge users and consumers.

6.2 The erosion of the 'gulf' between science and the public

Some protests emerged from within the scientific community in the 1970s. For instance, the 'scientific culture' movement denounced the increasing isolation of science from culture and society, while the 'science for the people' movement in the United Kingdom and 'Impa-science' in France debunked claims of neutrality (Debailly 2010). In the 1980s, the prestige and the authority of science started to come under attack from the public.

On one shore of the alleged 'gulf', the monopoly of expertise was questioned as a result of a number of public scandals, which brought to centre stage the collusion of interests between the scientific establishment and public or private interests. In France, during the Chernobyl disaster in 1986, the public authorities systematically denied that radioactivity on French territory had increased. They assumed that the radioactive cloud had stopped at the German and Italian borders and took no steps to prohibit the consumption of milk and vegetables. This attempt, against all factual evidence, to assuage the public's fears only generated public mistrust of both scientists and politicians.

That mistrust has since been deepened by revelations about deliberate attempts to conceal or dismiss certain data for economic reasons. For instance, the tobacco industry concealed or denied epidemiological data about the danger involved in smoking (Proctor & Schiebinger 2008). The attitude of Monsanto in the controversy surrounding genetically modified crops and, more recently, the disclosure of the risks associated with Bisphenol A have reinforced the public's conviction that commercial interests permeate and distort all scientific data (Robin 2008).

More widely spread is the growing scepticism about climate change. Despite a growing consensus among experts about climate change and its anthropic origin, doubts are widely publicized in order to prevent governments taking effective countermeasures (Oreskes & Conway 2010).

As a result of so many controversial affairs, science could hardly be considered as a value-free, neutral activity transcending power and ideologies. Instead, there is wide support in public opinion for a view of science as a domain dominated by economic interests and political orientations. For many people, all expertise is biased and the selection of experts is a political decision. The age of experts as those who 'speak truth to power' seems to be over (Jasanoff 2003).

On the other shore of the 'gulf', the view of the public as a mass of passive receivers of innovation has been eroded by a number of spectacular actions. In Germany, the anti-nuclear movement opposed the construction of nuclear plants,

stopped trains shipping nuclear waste, and organized protest sit-ins. In France, massive public protests against genetically modified organisms and the destruction of genetically modified trial crops have led to a temporary moratorium on the planting of Monsanto MON810 genetically modified corn. In 2006, the opening of Minatec, a big research centre in Grenoble dedicated to nanotechnology and neuroscience, spurred intense protests from a local organization named 'Pièce et main d'oeuvre'. This small group of determined, anonymous activists, using more or less humorous denunciations of the local lobby, drew public attention to the non-democratic nature of decisions and investments in nanotechnology. The group's purpose is to systematically debunk all research initiatives in nanotechnology and related technologies.

More constructive actions demonstrated that laypeople can produce legitimate knowledge. An early example of co-production of knowledge was in AIDS research. Patients contributed to experimental investigations—even conducting clinical trials on a specific drug after scientists had refused to do so (Epstein 1995, 1996). In France, a civil association was created in the aftermath of Chernobyl to challenge radiation measurements delivered by official institutions. Twenty-five years later, CRIIRAD (the Commission of Independent Research and Information on Radioactivity) is a legitimate non-profit organization in charge of risk surveillance and public information, equipped with permanent laboratories run by a dozen permanent employees supported by thousands of volunteers (Topçu 2008). Another civil counterexpertise organization based on that model—CRIIGEN (the Commission of Independent Research and Information on Genetic Engineering)—was founded in 1999. However, it is more like a group of experts-acting-as-citizens who develop an alternative approach to the risks and benefits of genetic engineering. Its results are periodically under attack and its members aredenounced as impostors or charlatans because they directly question the independence of academic research.

As a result of scandals and controversies about nuclear power, genetic engineering, nanotechnology and climate change, the clear-cut boundary between science and opinion collapsed in a few decades. The polarized landscape, with a small scientific elite holding a monopoly of truth language on the one hand, and a passive public submitting to the authority of experts on the other, has been deeply questioned. Science is now increasingly viewed as an archipelago of scattered islands populated by experts, as scientific controversies between experts on issues such as genetically modified crops and climate change have become more and more commonplace. Experts do not speak with a single voice and cannot reach a consensus. Although the English language has no plural for the abstract noun 'expertise', the plurality of expert opinions has been recognized (Bucchi & Neresini 2004, Bucchi & Trench 2008). And the public itself is no longer seen as an abstract entity, a mass of anonymous laypeople. They are individuals defending their interests and capable of producing knowledge. They are citizens aware of their rights. The erosion of the image of the gulf is so pronounced that the issue 'sci-

ence and the public' has been reformulated in terms of 'citizen science' (Irwin 1995).

6.3 The collapse of the ivory tower

The divide between scientists and the public could be maintained as long as science was perceived as a separate world, independent of the context in which it was practised. Scientific research, confined in closed laboratories, was supposed to be ruled exclusively by epistemic values such as truth, objectivity, and so on. However, the recent controversies (genetically modified organisms, climate change, personalized medicine, etc.) have revealed the social and political dimensions of scientific issues. Over the past two decades, social scientists have described science as highly context-sensitive and permeated by non-epistemic values such as 'competitiveness' or 'sustainable development' (Longino 1990, Gibbons et al. 1994).

Whether this is or is not a 'new regime of knowledge production' is a matter of debate, but what really matters is that officially science is no longer pursued as a disinterested and value-free activity. The dominant view in science policy is that scientific research is not an end in itself—it is oriented towards society and the economy. Science is no longer 'the endless frontier', as it was in Vannevar Bush's famous 1945 programme, which gave considerable autonomy to scientists. '*Society* is the endless frontier' is the European vision of research and innovation for the 21st century (Caracostas & Muldur 1997). Over the past two decades, technosciences such as information technology, biotechnology and nanotechnology have developed in parallel with the urge to refocus science on social concerns. Suddenly, the ivory tower of academic research opened to the world. Science policy became a major actor, and a crowd of industrial people, venture capitalists, users' groups, consumer associations, environmental activists, trade unions and NGOs came to the front of the stage and talked about science.

Along with the reorientation of scientific research towards societal or economic demands, the practice of science broke the walls within the ivory tower. Multidisciplinary research networks working for a few years on a specific research project tend to dissolve the strong disciplinary identities of academic scientists. They have to raise funds and make alliances with other laboratories, industrial companies and banks. They have to behave as entrepreneurs rather than comply with the traditional scientific ethos defined by the four pillars (universalism, disinterestedness, communalism, organized scepticism) (Merton 1973). In addition, the increasing role of computers, computer-based modelling and simulation is changing the epistemic culture deeply. In research fields such as genomics, investigations are aimed at the collection of innumerable data rather than the search for universal laws of nature. And computer sciences in their historical development have been much more open than conventional disciplines to amateur practices. Not only have hackers, free software and open source movements demonstrated that sound knowledge can be produced outside academic circles, but academic circles are oc-

casionally inviting amateurs to participate in their research, as exemplified by Stanford University's *Folding@home* project, which was launched to solve a problem related to protein folding. New epistemic cultures, such as distributed computational research or crowdsourcing for enrolling young talent in the exploration of new research areas, are emerging, blurring the traditional boundaries between academics and amateurs.

Does this mean that the age of experts and technocrats is over and that science is now more in the hands of citizens and under democratic control?

6.4 Towards a participatory model?

Science policymakers, NGOs and scientific communities seem to agree that more control of science is needed. They are increasingly concerned with frauds and conflicts of interests and call for more transparency. The concept of accountability, introduced in the 18th century to make the apparatus of government answerable to the public, has resurfaced as a major requirement for scientists in the late 20th century. Public investments in scientific research have to be legitimated, and scientific activities have to be scrutinized by public authorities. Social scientists have been engaged in a number of national research initiatives on nanotechnology or biotechnology. 'Responsible innovation' has become a catchphrase both in industrial research and in the public domain. Society, it seems, has to be present from the outset, upstream, on the laboratory floor.

In stark contrast to the former one-way science communication model, an impressive number of *dispositifs* have been developed to initiate a two-way traffic between citizens and scientists. Science cafes, public debates, consensus conferences, citizen conferences or juries, scenario workshops and hybrid forums are routinely organized in many European countries. The *cafés des sciences* recreate the public space where the notion of 'the public' emerged in the Enlightenment. In the standard process of a citizen conference, a panel of citizens is asked to formulate its opinion about a scientific or technological topic after hearing a number of experts and their opinions; its recommendations are publicized and can influence the decision-makers. When invited to participate upstream in the R&D phase, rather than downstream when innovations enter the market, assessors may prompt decisions in science policy and the imposition of new regulations.

Upstream technology assessment is not the only role that citizens can play. In hybrid forums, citizens are invited to cooperate in the construction of knowledge; they become legitimate co-producers of knowledge (Callon 1999, Callon et al. 2001). They are mobilized not only as individuals who volunteer to improve technology or to augment knowledge, but also on the basis of political activism. A number of NGOs, environmentalist movements, patient groups and consumer associations have set up their own laboratories and research facilities to produce their own expertise on specific issues such as medical research, radioactive contamination and genetic adulteration. They thus renew the tradition of 19th century advocates of popular science as an alternative science, such as Auguste Comte,

François Raspail and Victor Meunier (Bensaude-Vincent 1988). Their mission is not exactly the social control of science that 19th century science popularizers envisaged, but is something like a surveillance of experts. Their frequent claims of 'independent expertise' suggest that the knowledge produced by scientists is not independent, loaded as it is with public or private interests. However, that phrase is misleading because the knowledge produced by active citizens is neither value-free nor disinterested. It is through the confrontation of various experts that one can expect to approximate the truth.

It is too early to evaluate the impacts of such *dispositifs* on science and society. To be sure, science and technology have entered the public arena and are discussed in the agora, but it would be naive to think that a couple of hybrid forums and citizen panels alone have the ability to put science and opinion on an equal footing. Public participation remains confined to a very limited set of technoscientific issues. Citizens' interventions in the process of decision-making have so far been extremely limited, and the citizen panels are by no means representative of the public opinion because activists are systematically discarded. Often the motivations for engaging the public upstream are to prevent the public rejection of new technologies, to avoid controversy and to foster public acceptance of innovations. Is it social engineering or participatory democracy?

More precisely, the governanceof science by bringing together the 'stakeholders' at a round table is inspired by a management technique initially developed in industrial companies. In this model, the norms of management—success, efficiency—replace the normativity of law as well as the normativity of science (Bruno 2008:75–76). The same managerial inspiration prevails in the role assigned to the social scientists engaged upstream in research programmes. They have to anticipate the potential impacts of new technologies on ethics, the economy, society and law. They have to identify key issues and potential risks, to balance costs and benefits, and so on. In other words, they have to adopt the instrumental rationality that prevails in science and technology. This appears to be a technocratic control of society as much as a democratic control of science and technology.

In conclusion, the relations between science and opinion have been continuously reconfigured since the dawn of western science in Greece. However, it would be simplistic to conclude that we have shifted from a deficit model of the public as those who do not know to a democratic model of active citizens participating in the advancement of science.

The emerging participatory model has not yet prevailed over the deficit model. Many scientists and citizens are still convinced that there is an increasing gulf between science and the public, and that laypeople cannot have an opinion about scientific choices. The deficit model that prevailed in the 20th century did not eradicate the earlier model of the enlightened public. There have been no paradigm shifts, although novel characterizations of the public emerge continuously. New roles for the public may prevail, but they never overthrow the earlier roles and concepts.

Many rival images of science and the public are competing in today's society. Through this perpetual struggle, science and the public are mutually shaped and reshaped. Their interactions or isolation determine the role of science in society and the public attitude towards science.

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